

A photograph of an estuarine wetland. In the foreground, there are clumps of tall, thin, reddish-brown grasses growing out of dark water. The water reflects the sky and the surrounding vegetation. In the background, a grassy bank rises from the water's edge. The overall scene is a natural, undisturbed wetland environment.

California Rapid Assessment Method for Wetlands

version 5.0.2

Estuarine Wetlands Field Book

September 2008

Basic Information Sheet: Estuarine Wetlands

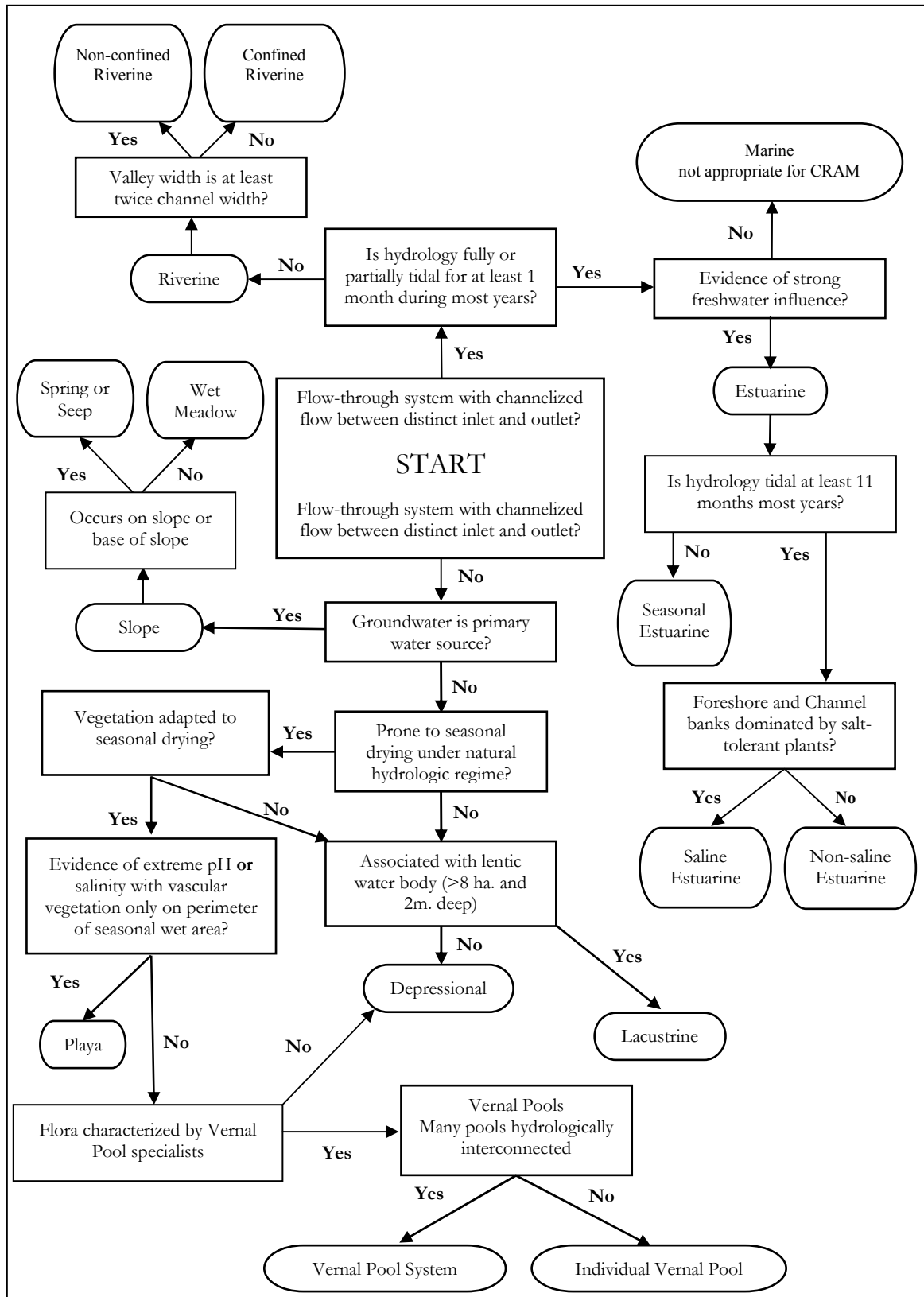
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What best describes the tidal stage over the course of the time spent in the field? Note: It is recommended that the assessment be conducted during low tide. <div style="text-align: center;"> <input type="checkbox"/> high tide <input type="checkbox"/> low tide </div>																																															
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Scoring Sheet: Estuarine Wetlands

AA Name:		(m/d/y)			
Attributes and Metrics		Scores		Comments	
Buffer and Landscape Context					
Landscape Connectivity (D)					
Buffer submetric A: <i>Percent of AA with Buffer</i>					
Buffer submetric B: <i>Average Buffer Width</i>					
Buffer submetric C: <i>Buffer Condition</i>					
$D + [C \times (A \times B)^{1/2}]^{1/2} = \text{Attribute Score}$		Raw	Final	Final Attribute Score = (Raw Score/24)100	
Hydrology					
Water Source					
Hydroperiod or Channel Stability					
Hydrologic Connectivity					
Attribute Score		Raw	Final	Final Attribute Score = (Raw Score/36)100	
Physical Structure					
Structural Patch Richness					
Topographic Complexity					
Attribute Score		Raw	Final	Final Attribute Score = (Raw Score/24)100	
Biotic Structure					
Plant Community submetric A: <i>Number of Plant Layers</i>					
Plant Community submetric B: <i>Number of Co-dominant species</i>					
Plant Community submetric C: <i>Percent Invasion</i>					
Plant Community Metric <i>(average of submetrics A-C)</i>					
Horizontal Interspersion and Zonation					
Vertical Biotic Structure					
Attribute Score		Raw	Final	Final Attribute Score = (Raw Score/36)100	
Overall AA Score				Average of Final Attribute Scores	

Identify Wetland Type

Figure 3.2: Flowchart to determine wetland type and sub-type.



3.2.2.5.1 Perennial Saline Estuarine Wetland Sub-type

For the purposes of CREAM, saline estuarine wetlands are distinguished from non-saline estuarine wetlands by the obvious dominance of salt-tolerant species of emergent vascular vegetation, such as cordgrass (*Spartina* spp.), pickleweed (*Salicornia* spp.), and salt grass (*Distichlis* spp.) along the foreshore of the wetland and along the immediate banks of the larger tidal channels that tend to dewater at low tide.

3.2.2.5.2 Perennial Non-saline Estuarine Wetland Sub-type

In non-saline wetlands (i.e., brackish or freshwater estuarine wetlands), the plant community along the foreshore of the wetland and along the immediate banks of the larger tidal channels that tend to dewater at low tide is dominated by species that don't tolerate high salinities, such as cattails (*Typha* spp.), rushes (*Scirpus species*), and willows (*Salix* spp.).

3.2.2.5.3 Seasonal Estuarine Wetland Sub-type

Seasonal estuaries are the reaches of coastal rivers and streams that are ecologically influenced by seasonal closures of their tidal inlets. The frequency and duration of inlet closure can be natural or managed. The tidal regime can be muted or not (i.e., the tidal range can be the same or less than that of the adjacent marine or estuarine system when the tidal inlet is open). The salinity regime of a seasonal estuary can be highly variable. It can be fresh throughout very wet years or hypersaline during extended droughts. Some seasonal estuaries are locally referred to as lagoons.

Establish the Assessment Area (AA)

Table 3.5: Examples of features that *should* be used to delineate AA boundaries.

Flow-Through Wetlands	Non Flow-Through Wetlands	
Riverine, Estuarine and Slope Wetlands	Lacustrine, Wet Meadows, Depressional, and Playa Wetlands	Vernal Pools and Vernal Pool Systems
<ul style="list-style-type: none"> • diversion ditches • end-of-pipe large discharges • grade control or water height control structures • major changes in riverine entrenchment, confinement, degradation, aggradation, slope, or bed form • major channel confluences • water falls • open water areas more than 50 m wide on average or broader than the wetland • transitions between wetland types • foreshores, backshores and uplands at least 5 m wide • weirs, culverts, dams, levees, and other flow control structures 	<ul style="list-style-type: none"> • above-grade roads and fills • berms and levees • jetties and wave deflectors • major point sources or outflows of water • open water areas more than 50 m wide on average or broader than the wetland • foreshores, backshores and uplands at least 5 m wide • weirs and other flow control structures 	<ul style="list-style-type: none"> • above-grade roads and fills • major point sources of water inflows or outflows • weirs, berms, levees and other flow control structures

Table 3.6: Examples of features that *should not* be used to delineate any AAs.

<ul style="list-style-type: none"> • at-grade, unpaved, single-lane, infrequently used roadways or crossings • bike paths and jogging trails at grade • bare ground within what would otherwise be the AA boundary • equestrian trails • fences (unless designed to obstruct the movement of wildlife) • property boundaries • riffle (or rapid) – glide – pool transitions in a riverine wetland • spatial changes in land cover or land use along the wetland border • state and federal jurisdictional boundaries

Table 3.7: Recommended maximum and minimum AA sizes for each wetland type.
Note: Wetlands smaller than the recommended AA sizes can be assessed in their entirety.

Wetland Type	Recommended AA Size
Slope	
Spring or Seep	Maximum size is 0.50 ha (about 75 m x 75 m, but shape can vary); there is no minimum size.
Wet Meadow	Maximum size is 2.25 ha (about 150 m x 150 m, but shape can vary); minimum size is 0.1 ha (about 30 m x 30 m).
Depressional	
Vernal Pool	There are no size limits (see Section 3.5.6 and Table 3.8).
Vernal Pool System	There are no size limits (see Section 3.5.6 and Table 3.8).
Other Depressional	Maximum size is 1.0 ha (about 100 m x 100 m, but shape can vary); there is no minimum size.
Riverine	
Confined and Non-confined	Recommended length is 10x average bankfull channel width; maximum length is 200 m; minimum length is 100 m. AA should extend laterally (landward) from the bankfull contour to encompass all the vegetation (trees, shrubs vines, etc) that probably provide woody debris, leaves, insects, etc. to the channel and its floodplain (Figure 3.4); minimum width is 2 m.
Lacustrine	Maximum size is 2.25 ha (about 150 m x 150 m, but shape can vary); minimum size is 0.5 ha (about 75 m x 75 m).
Playa	Maximum size is 2.25 ha (about 150 m x 150 m, but shape can vary); minimum size is 0.5 ha (about 75 m x 75 m).
Estuarine	
Perennial Saline	Recommended size and shape for estuarine wetlands is a 1 ha circle (radius about 55 m), but the shape can be non-circular if necessary to fit the wetland and to meet hydrogeomorphic and other criteria as outlined in Sections 3.5.1-3. The minimum size is 0.1 ha (about 30 m x 30 m).
Perennial Non-saline	
Seasonal	

Attribute 1: Buffer and Landscape Context

Special Considerations for Estuarine Wetlands

The boundary of an estuarine wetland AA should be determined during low tide. The AA should not extend above the backshore, as indicated by wrack lines, transitions from intertidal to upland vegetation, etc., and it should not extend more than 10 m across a non-vegetated tidal flat that adjoins the foreshore. The AA should not extend across any tidal channel that is wider than 30 m or that cannot be safely crossed at low tide. The boundary of the AA can extend along the midline of such channels but not across them. The AA can incorporate any smaller channels that can be safely crossed on the ground. The AA will therefore include all of the intertidal marsh plain and associated features, such as pannes and natural levees, plus all of the tidal channels that can be crossed, plus the exposed banks and beds of channels that border the AA. But, the AA should not extend further than 10 m onto any tidal flat that adjoins the foreshore (Figure 3.5).

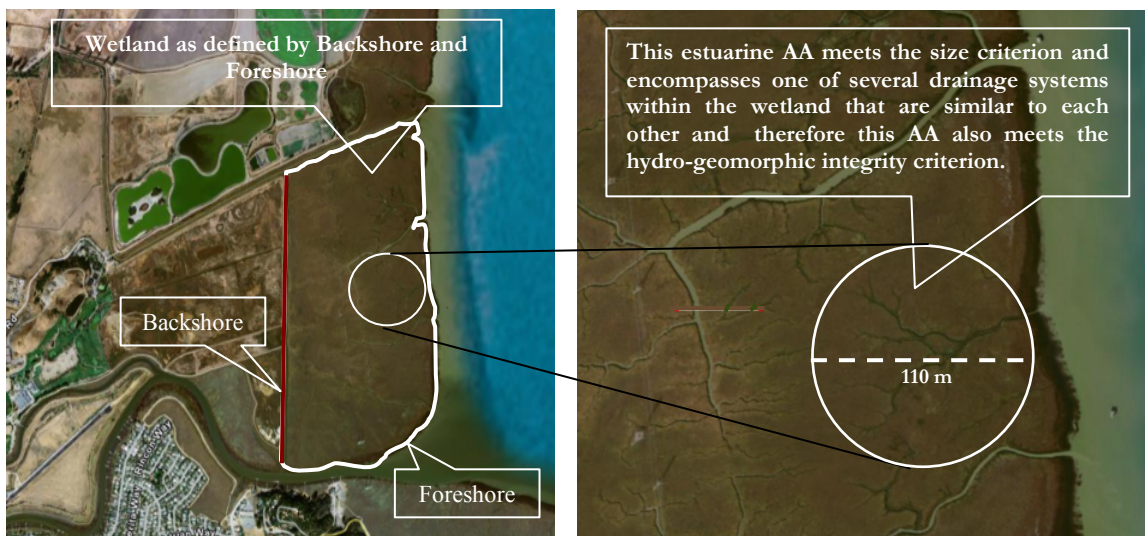


Figure 3.5: Example of an estuarine wetland and its characteristic Assessment Area.

Landscape Connectivity

Definition: The landscape connectivity of an Assessment Area is assessed in terms of its spatial association with other areas of aquatic resources, such as other wetlands, lakes, streams, etc. It is assumed that wetlands close to each other have a greater potential to interact ecologically and hydrologically, and that such interactions are generally beneficial.

For all wetlands except riverine: On digital or hardcopy site imagery, draw a straight line extending 500 m from the AA boundary in each of the four cardinal compass directions. Along each transect line, estimate the percentage of the segment that passes through wetland or aquatic habitat of any kind, including open water. Use the worksheet below to record these estimates.

Worksheet for Landscape Connectivity Metric for All Wetlands Except Riverine

Percentage of Transect Lines that Contains Wetland Habitat of Any Kind	
Segment Direction	Percentage of Transect Length That is Wetland
North	
South	
East	
West	
Average Percentage of Transect Length That Is Wetland	

Table 4.1: Rating for Landscape Connectivity for all wetlands except Riverine.

Rating	Alternative States
A	An average of 76 – 100 % of the transects is wetland habitat of any kind.
B	An average of 51 – 75 % of the transects is wetland habitat of any kind.
C	An average of 26 – 50 % of the transects is wetland habitat of any kind.
D	An average of 0 – 25 % of the transects is wetland habitat of any kind.

Percent of AA with Buffer

Definition: The buffer is the area adjoining the AA that is in a natural or semi-natural state and currently not dedicated to anthropogenic uses that would severely detract from its ability to entrap contaminants, discourage forays into the AA by people and non-native predators, or otherwise protect the AA from stress and disturbance.

To be considered as buffer, a suitable land cover type must be at least 5 m wide and extend along the perimeter of the AA for at least 5 m. The maximum width of the buffer is 250 m. At distances beyond 250 m from the AA, the buffer becomes part of the landscape context of the AA.

Any area of open water at least 30 m wide that is adjoining the AA, such as a lake, large river, or large slough, is not considered in the assessment of the buffer. Such open water is considered to be neutral, neither part of the wetland nor part of the buffer. There are three reasons for excluding large areas of open water (i.e., more than 30 m wide) from Assessment Areas and their buffers. First, assessments of buffer extent and buffer width are inflated by including open water as a part of the buffer. Second, while there may be positive correlations between wetland stressors and the quality of open water, quantifying water quality generally requires laboratory analyses beyond the scope of rapid assessment. Third, open water can be a direct source of stress (i.e., water pollution, waves, boat wakes) or an indirect source of stress (i.e., promotes human visitation, encourages intensive use by livestock looking for water, provides dispersal for non-native plant species), or it can be a source of benefits to a wetland (e.g., nutrients, propagules of native plant species, water that is essential to maintain wetland hydroperiods, etc.). However, any area of open water at least 30 m wide that is within 250 m of the AA but is not adjoining the AA is considered part of the buffer.

In the example below (Figure 4.2), most of the area around the AA (outlined in white) consists of non-buffer land cover types. The AA adjoins a major roadway, parking lot, and other development that is a non-buffer land cover type. There is a nearby wetland but it is separated from the AA by a major roadway and is not considered buffer. The open water area is neutral and not considered in the estimation of the percentage of the AA perimeter that has buffer. In this example, the only areas that would be considered buffer is the area labeled “Upland Buffer”.

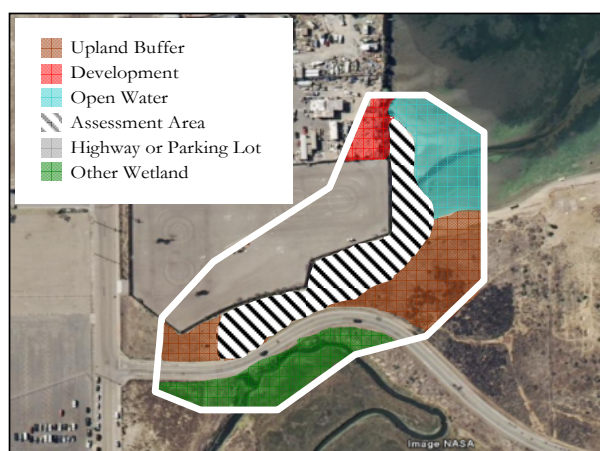


Figure 4.2: Diagram of buffer and non-buffer land cover types.

Table 4.4: Guidelines for identifying wetland buffers and breaks in buffers.

Examples of Land Covers Included in Buffers	Examples of Land Covers Excluded from Buffers Notes: buffers do not cross these land covers; areas of open water adjacent to the AA are not included in the assessment of the AA or its buffer.
<ul style="list-style-type: none"> • bike trails • dry-land farming areas • foot trails • horse trails • links or target golf courses • natural upland habitats • nature or wildland parks • open range land • railroads • roads not hazardous to wildlife • swales and ditches • vegetated levees 	<ul style="list-style-type: none"> • commercial developments • fences that interfere with the movements of wildlife • intensive agriculture (row crops, orchards and vineyards lacking ground cover and other BMPs) • paved roads (two lanes plus a turning lane or larger) • lawns • parking lots • horse paddocks, feedlots, turkey ranches, etc. • residential areas • sound walls • sports fields • traditional golf courses • urbanized parks with active recreation • pedestrian/bike trails (i.e., nearly constant traffic)

Table 4.5: Rating for Percent of AA with Buffer.

Rating	Alternative States (not including open-water areas)
A	Buffer is 75 - 100% of AA perimeter.
B	Buffer is 50 – 74% of AA perimeter.
C	Buffer is 25 – 49% of AA perimeter.
D	Buffer is 0 – 24% of AA perimeter.

Average Buffer Width

Definition: The average width of the buffer adjoining the AA is estimated by averaging the lengths of eight straight lines drawn at regular intervals around the AA from its perimeter outward to the nearest non-buffer land cover or 250 m, whichever is first encountered. It is assumed that the functions of the buffer do not increase significantly beyond an average width of about 250 m. The maximum buffer width is therefore 250 m. The minimum buffer width is 5 m, and the minimum length of buffer along the perimeter of the AA is also 5 m. Any area that is less than 5 m wide and 5 m long is too small to be a buffer. See Table 4.4 above for more guidance regarding the identification of AA buffers.

Table 4.6: Steps to estimate Buffer Width for all wetlands.

Step 1	Identify areas in which open water is directly adjacent to the AA, with no vegetated intertidal or upland area in between. These areas are excluded from buffer calculations.
Step 2	Draw straight lines 250 m in length perpendicular to the AA through the buffer area at regular intervals along the portion of the perimeter of the AA that has a buffer. For one-sided riverine AAs, draw four lines; for all other wetland types, draw eight lines (see Figures 4.3 and 4.4 below).
Step 3	Estimate the buffer width of each of the lines as they extend away from the AA. Record these lengths on the worksheet below.
Step 4	Estimate the average buffer width. Record this width on the worksheet below.

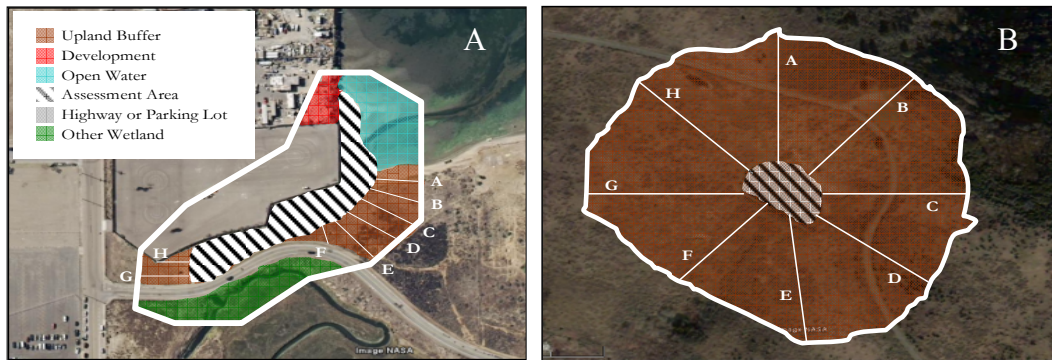


Figure 4.3: Examples of the method used to estimate Buffer Width. Note that the width is based on the lengths of eight lines A-H that extend at regular intervals through the buffer areas, whether only a small part of the 250 m zone around the AA is buffer (A) or all of the zone around the AA is buffer (B).

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	
B	
C	
D	
E	
F	
G	
H	
Average Buffer Width	

Table 4.7: Rating for average buffer width.

Rating	Alternative States
A	Average buffer width is 190 – 250 m.
B	Average buffer width 130 – 189 m.
C	Average buffer width is 65 – 129 m.
D	Average buffer width is 0 – 64 m.

Buffer Condition

Definition: The condition of a buffer is assessed according to the extent and quality of its vegetation cover and the overall condition of its substrate. Evidence of direct impacts by people are excluded from this metric and included in the Stressor Checklist. Buffer conditions are assessed only for the portion of the wetland border that has already been identified or defined as buffer, based on Section 4.1.2 above. If there is no buffer, assign a score of D.

Table 4.8: Rating for Buffer Condition.

Rating	Alternative States
A	Buffer for AA is dominated by native vegetation, has undisturbed soils, and is apparently subject to little or no human visitation.
B	Buffer for AA is characterized by an intermediate mix of native and non-native vegetation, but mostly undisturbed soils and is apparently subject to little or no human visitation.
C	Buffer for AA is characterized by substantial amounts of non-native vegetation AND there is at least a moderate degree of soil disturbance/compaction, and/or there is evidence of at least moderate intensity of human visitation.
D	Buffer for AA is characterized by barren ground and/or highly compacted or otherwise disturbed soils, and/or there is evidence of very intense human visitation.

Attribute 2: Hydrology

Water Source

Definition: Water Sources directly affect the extent, duration, and frequency of saturated or ponded conditions within an Assessment Area. Water Sources include the kinds of direct inputs of water into the AA as well as any diversions of water from the AA. Diversions are considered a water source because they affect the ability of the AA to function as a source of water for other habitats while also directly affecting the hydrology of the AA.

A water source is direct if it supplies water mainly to the AA, rather than to areas through which the water must flow to reach the AA. Natural, direct sources include rainfall, ground water discharge, and flooding of the AA due to high tides or naturally high riverine flows. Examples of unnatural, direct sources include stormdrains that empty directly into the AA or into an immediately adjacent area. For seeps and springs that occur at the toes of earthen dams, the reservoirs behind the dams are direct water source. Indirect sources that should not be considered in this metric include large regional dams or urban storm drain systems that do not drain directly into the AA but that have systemic, ubiquitous effects on broad geographic areas of which the AA is a small part. For example, the salinity regimes of estuarine wetlands in San Francisco Bay are affected by dams in the Sierra Nevada, but these effects are not direct. But some of the same wetlands are directly affected by nearby discharges from sewage treatment facilities. Engineered hydrological controls, such as weirs, tide gates, flashboards, grade control structures, check dams, etc., can serve to demarcate the boundary of an AA (see Section 3.5), but they are not considered water sources.

The typical suite of natural water sources differs among the wetland types. The water for estuarine wetlands is by definition a combination of marine (i.e., tidal) and riverine (i.e., fluvial) sources. This metric is focused on the non-tidal water sources that account for the conditions during the growing season, regardless of the time of year when these sources exist. To assess water source, the plant species composition of the wetland should be compared to what is expected, in terms of the position of the wetland along the salinity gradient of the estuary, as adjusted for the overall wetness of the water year. In general, altered sources are indicated by vegetation that is either more tolerant of saline conditions or less tolerant than would be expected. If the plant community is unexpectedly salt-tolerant, then an unnatural decrease in freshwater supply is indicated. Conversely, if the community is less salt-tolerant than expected, then an unnatural increase in freshwater is indicated.

Table 4.9: Rating for Water Source.

Rating	Alternative States
A	Freshwater sources that affect the dry season condition of the AA, such as its flow characteristics, hydroperiod, or salinity regime, are precipitation, groundwater, and/or natural runoff, or natural flow from an adjacent freshwater body, or the AA naturally lacks water in the dry season. There is no indication that dry season conditions are substantially controlled by artificial water sources.
B	Freshwater sources that affect the dry season condition of the AA are mostly natural, but also obviously include occasional or small effects of modified hydrology. Indications of such anthropogenic inputs include developed land or irrigated agricultural land that comprises less than 20% of the immediate drainage basin within about 2 km upstream of the AA, or that is characterized by the presence of a few small stormdrains or scattered homes with septic systems. No large point sources or dams control the overall hydrology of the AA.
C	<p>Freshwater sources that affect the dry season conditions of the AA are primarily urban runoff, direct irrigation, pumped water, artificially impounded water, water remaining after diversions, regulated releases of water through a dam, or other artificial hydrology. Indications of substantial artificial hydrology include developed or irrigated agricultural land that comprises more than 20% of the immediate drainage basin within about 2 km upstream of the AA, or the presence of major point source discharges that obviously control the hydrology of the AA.</p> <p style="text-align: center;">OR</p> <p>Freshwater sources that affect the dry season conditions of the AA are substantially controlled by known diversions of water or other withdrawals directly from the AA, its encompassing wetland, or from its drainage basin.</p>
D	Natural, freshwater sources that affect the dry season conditions of the AA have been eliminated based on the following indicators: impoundment of all possible wet season inflows, diversion of all dry-season inflow, predominance of xeric vegetation, etc.

Hydroperiod or Channel Stability

Definition: Hydroperiod is the characteristic frequency and duration of inundation or saturation of a wetland during a typical year. The natural hydroperiod for estuarine wetlands is governed by the tides, and includes predictable variations in inundation regimes over days, weeks, months, and seasons. Depressional, lacustrine, playas, and riverine wetlands typically have daily variations in water height that are governed by diurnal increases in evapotranspiration and seasonal cycles that are governed by rainfall and runoff. Seeps and springs that depend on groundwater may have relatively slight seasonal variations in hydroperiod.

Channel stability only pertains to riverine wetlands. It is assessed as the degree of channel aggradation (i.e., net accumulation of sediment on the channel bed causing it to rise over time), or degradation (i.e., net loss of sediment from the bed causing it to be lower over time). There is much interest in channel entrenchment (i.e., the inability of flows in a channel to exceed the channel banks) and this is addressed in the Hydrologic Connectivity metric.

Table 4.10: Field Indicators of Altered Hydroperiod.

Direct Engineering Evidence	Indirect Ecological Evidence
Reduced Extent and Duration of Inundation or Saturation	
<ul style="list-style-type: none"> Upstream spring boxes Impoundments Pumps, diversions, ditching that move water <i>into</i> the wetland 	<ul style="list-style-type: none"> Evidence of aquatic wildlife mortality Encroachment of terrestrial vegetation Stress or mortality of hydrophytes Compressed or reduced plant zonation
Increased Extent and Duration of Inundation or Saturation	
<ul style="list-style-type: none"> Berms Dikes Pumps, diversions, ditching that move water <i>into</i> the wetland 	<ul style="list-style-type: none"> Late-season vitality of annual vegetation Recently drowned riparian vegetation Extensive fine-grain deposits

Perennial Estuarine: The volume of water that flows into and from an estuarine wetland due to the changing stage of the tide is termed the “tidal prism.”

The tidal prism consists of inputs from both tidal (i.e., marine or estuarine) and non-tidal (e.g., fluvial or upland) sources. The timing, duration, and frequency of inundation of the wetland by these waters are collectively referred to the tidal hydroperiod.

Under natural conditions, increases in tidal prism tend to cause increases in inorganic sedimentation, which raises the tidal elevation of the wetland and thus reduces its hydroperiod. If the sediment supply is adequate, estuarine marshes tend to build upward in quasi-equilibrium with sea level rise.

A change in the hydroperiod of an estuarine wetland (i.e., a change in the tidal prism) can be inferred from changes in channel morphology, drainage network density, and the relative abundance of plants indicative of either high or low marsh. A preponderance of shrink-swell cracks or dried pannes on the wetland plain is indicative of decreased hydroperiod. In addition, inadequate tidal flushing may be indicated by algal blooms or by encroachment of freshwater vegetation. Dikes, levees, ponds, or ditches are indicators of an altered hydroperiod resulting from management for flood control, salt production, waterfowl hunting, mosquito control, etc. Table 4.12 provides narratives for rating Hydroperiod for perennial estuarine wetlands.

Seasonal Estuarine: The hydroperiod of a seasonal estuarine wetland can be highly variable due to interannual variations in freshwater inputs and occasional breaching of the tidal barrier.

For the purposes of CRAM, the fringing wetland of a seasonal estuary is assessed as a perennial estuarine wetland when its inlet is open, but is assessed as riverine wetland if its inlet is closed.

Hydroperiod alteration can be inferred from atypical wetting and drying patterns along the shoreline (e.g., a preponderance of shrink-swell cracks or dried pannes). Inadequate tidal flushing, or, in arid systems, excessive freshwater input during the dry season may be indicated by algal blooms or by encroachment of freshwater vegetation. Dikes, levees, ponds, ditches, and tide-control structures are indicators of an altered hydroperiod resulting from management for flood control, salt production, waterfowl hunting, mosquito control, boating, etc. Table 4.13 provides narratives for rating Hydroperiod for seasonal estuarine wetlands.

Table 4.12: Rating of Hydroperiod for Perennial Estuarine wetlands.

Rating	Alternative States
A	AA is subject to the full tidal prism, with two daily tidal minima and maxima.
B	AA is subject to reduced, or muted, tidal prism, although two daily minima and maxima are observed.
C	AA is subject to muted tidal prism, with tidal fluctuations evident only in relation to extreme daily highs or spring tides.
D	AA is subject to muted tidal prism, plus there is inadequate drainage, such that the marsh plain tends to remain flooded during low tide.

Table 4.13: Rating of Hydroperiod for Seasonal Estuarine wetlands.

Rating	Alternative States
A	AA is subject to natural interannual tidal fluctuations (range may be severely muted or vary seasonally), and episodically has tidal inputs by natural breaching due to either fluvial flooding or storm surge.
B	AA is subject to tidal inputs more often than would be expected under natural circumstances, because of artificial breaching of the tidal inlet.
C	AA is subject to tidal inputs less often than would be expected under natural circumstances due to management of the inlet to prevent its opening.
D	AA is rarely subject to natural tidal inputs.

Hydrologic Connectivity

Definition: Hydrologic Connectivity describes the ability of water to flow into or out of the wetland, or to accommodate rising flood waters without dramatic changes in water level, which can result in stress to wetland plants and animals. This metric pertains only to Riverine, Estuarine, Vernal Pool Systems, Individual Vernal Pools, Depressional, and Playas.

This metric is scored by assessing the degree to which the lateral movement of flood waters or the associated upland transition zone of the AA and/or its encompassing wetland is restricted by unnatural features such as levees, sea walls, or road grades.

For estuarine wetlands, this metric should be scored by considering anthropogenic restrictions on the tidal hydrology. **The percentage of restriction should be calculated only in consideration of those features (levees, dikes, seawalls, transpiration infrastructure, or other fills) that restrict flood tides.**

Table 4.15c: Rating of Hydrologic Connectivity for Estuarine, Depressional, Lacustrine, and Slope wetlands, Playas, Individual Vernal Pools, and Vernal Pool Systems.

Rating	Alternative States
A	Rising water in the wetland that contains the AA has unrestricted access to adjacent areas, without levees or other obstructions to the lateral movement of flood waters.
B	There are unnatural features such as levees or road grades that limit the amount of adjacent transition zone or the lateral movement of flood waters, relative to what is expected for the setting. But, the limitations exist for less than 50% of the boundary of wetland that contains the AA. Restrictions may be intermittent along margins of the wetland, or they may occur only along one bank or shore of the wetland. Flood flows may exceed the obstructions, but drainage back to the wetland is obstructed.
C	The amount of adjacent transition zone or the lateral movement of flood waters is limited, relative to what is expected for the setting, by unnatural features, such as levees or road grades, for 50-90% of the wetland that contains the AA. Flood flows may exceed the obstructions, but drainage back to the wetland is obstructed.
D	The amount of adjacent transition zone or the lateral movement of flood waters is limited, relative to what is expected for the setting, by unnatural features, such as levees or road grades, for more than 90% of the wetland that contains the AA.

Attribute 3: Physical Structure

Structural Patch Richness

Definition: Patch richness is the number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian species. This metric is different from topographic complexity in that it addresses the number of different patch types, whereas topographic complexity evaluates the spatial arrangement and interspersed of the types. Physical patches can be natural or unnatural.

Patch Type Definitions:

Animal mounds and burrows. Many vertebrates make mounds or holes as a consequence of their foraging, denning, predation, or other behaviors. The resulting soil disturbance helps to redistribute soil nutrients and influences plant species composition and abundance. To be considered a patch type there should be evidence that a population of burrowing animals has occupied the Assessment Area. A single burrow or mound does not constitute a patch.

Bank slumps or undercut banks in channels or along shorelines. A bank slump is a portion of a depression, estuarine, or lacustrine bank that has broken free from the rest of the bank but has not eroded away. Undercuts are areas along the bank or shoreline of a wetland that have been excavated by waves or flowing water.

Cobble and boulders. Cobble and boulders are rocks of different size categories. The long axis of cobble ranges from about 6 cm to about 25 cm. A boulder is any rock having a long axis greater than 25 cm. Submerged cobbles and boulders provide abundant habitat for aquatic macroinvertebrates and small fish. Exposed cobbles and boulders provide roosting habitat for birds and shelter for amphibians. They contribute to patterns of shade and light and air movement near the ground surface that affect local soil moisture gradients, deposition of seeds and debris, and overall substrate complexity.

Concentric or parallel high water marks. Repeated variation in water level in a wetland can cause concentric zones in soil moisture, topographic slope, and chemistry that translate into visible zones of different vegetation types, greatly increasing overall ecological diversity. The variation in water level might be natural (e.g., seasonal) or anthropogenic.

Debris jams. A debris jam is an accumulation of drift wood and other flotsam across a channel that partially or completely obstructs surface water flow.

Hummocks or sediment mounds. Hummocks are mounds created by plants in slope wetlands, depressions, and along the banks and floodplains of fluvial and tidal systems. Hummocks are typically less than 1m high. Sediment mounds are similar to hummocks but lack plant cover.

Islands (exposed at high-water stage). An island is an area of land above the usual high water level and, at least at times, surrounded by water in a riverine, lacustrine, estuarine, or playa system. Islands differ from hummocks and other mounds by being large enough to support trees or large shrubs.

Macroalgae and algal mats. Macroalgae occurs on benthic sediments and on the water surface of all types of wetlands. Macroalgae are important primary producers, representing the base of the food web in some wetlands. Algal mats can provide abundant habitat for macro-invertebrates, amphibians, and small fishes.

Non-vegetated flats (sandflats, mudflats, gravel flats, etc.). A flat is a non-vegetated area of silt, clay, sand, shell hash, gravel, or cobble at least 10 m wide and at least 30 m long that adjoins the wetland

foreshore and is a potential resting and feeding area for fishes, shorebirds, wading birds, and other waterbirds. Flats can be similar to large bars (see definitions of point bars and in-channel bars below), except that they lack the convex profile of bars and their compositional material is not as obviously sorted by size or texture.

Pannes or pools on floodplain. A panne is a shallow topographic basin lacking vegetation but existing on a well-vegetated wetland plain. Pannes fill with water at least seasonally due to overland flow. They commonly serve as foraging sites for waterbirds and as breeding sites for amphibians.

Point bars and in-channel bars. Bars are sedimentary features within intertidal and fluvial channels. They are patches of transient bedload sediment that form along the inside of meander bends or in the middle of straight channel reaches. They sometimes support vegetation. They are convex in profile and their surface material varies in size from small on top to larger along their lower margins. They can consist of any mixture of silt, sand, gravel, cobble, and boulders.

Pools in channels. Pools are areas along tidal and fluvial channels that are much deeper than the average depths of their channels and that tend to retain water longer than other areas of the channel during periods of low or no surface flow.

Riffles or rapids. Riffles and rapids are areas of relatively rapid flow and standing waves in tidal or fluvial channels. Riffles and rapids add oxygen to flowing water and provide habitat for many fish and aquatic invertebrates.

Secondary channels on floodplains or along shorelines. Channels confine riverine or estuarine flow. A channel consists of a bed and its opposing banks, plus its floodplain. Estuarine and riverine wetlands can have a primary channel that conveys most flow, and one or more secondary channels of varying sizes that convey flood flows. The systems of diverging and converging channels that characterize braided and anastomosing fluvial systems usually consist of one or more main channels plus secondary channels. Tributary channels that originate in the wetland and that only convey flow between the wetland and the primary channel are also regarded as secondary channels. For example, short tributaries that are entirely contained within the CRAM Assessment Area (AA) are regarded as secondary channels.

Shellfish beds. Oysters, clams and mussels are common bivalves that create beds on the banks and bottoms of wetland systems. Shellfish beds influence the condition of their environment by affecting flow velocities, providing substrates for plant and animal life, and playing particularly important roles in the uptake and cycling of nutrients and other water-borne materials.

Soil cracks. Repeated wetting and drying of fine grain soil that typifies some wetlands can cause the soil to crack and form deep fissures that increase the mobility of heavy metals, promote oxidation and subsidence, while also providing habitat for amphibians and macroinvertebrates. Cracks must be a minimum of 1 inch deep to qualify.

Standing snags. Tall, woody vegetation, such as trees and tall shrubs, can take many years to fall to the ground after dying. These standing “snags” they provide habitat for many species of birds and small mammals. Any standing, dead woody vegetation that is at least 3 m tall is considered a snag.

Submerged vegetation. Submerged vegetation consists of aquatic macrophytes such as *Elodea canadensis* (common elodea), and *Zostera marina* (eelgrass) that are rooted in the sub-aqueous substrate but do not usually grow high enough in the overlying water column to intercept the water surface. Submerged vegetation can strongly influence nutrient cycling while providing food and shelter for fish and other organisms.

Swales on floodplain or along shoreline. Swales are broad, elongated, vegetated, shallow depressions that can sometimes help to convey flood flows to and from vegetated marsh plains or floodplains. But, they lack obvious banks, regularly spaced deeps and shallows, or other characteristics of channels. Swales can entrap water after flood flows recede. They can act as localized recharge zones and they can sometimes receive emergent groundwater.

Variegated or crenulated foreshore. As viewed from above, the foreshore of a wetland can be mostly straight, broadly curving (i.e., arcuate), or variegated (e.g., meandering). In plan view, a variegated shoreline resembles a meandering pathway. variegated shorelines provide greater contact between water and land.

Wreckline or organic debris in channel or on floodplain. Wreck is an accumulation of natural or unnatural floating debris along the high water line of a wetland.

Structural Patch Type Worksheet for All Wetland Types, Except Vernal Pool Systems

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table 4.16 below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see section 3.2.2.1).

STRUCTURAL PATCH TYPE (check for presence)	Riverine (Non-confined)	Riverine (Confined)	All Estuarine	Depressional	Slope Wetlands	Lacustrine	Individual Vernal Pools	Playas
Minimum Patch Size	3 m ²	3 m ²	3 m ²	3 m ²	1 m ²	3 m ²	1 m ²	3 m ²
Secondary channels on floodplains or along shorelines	1	0	1	0	1	1	0	1
Swales on floodplain or along shoreline	1	0	0	1	1	1	1	1
Pannes or pools on floodplain	1	0	1	0	1	1	1	1
Vegetated islands (mostly above high-water)	1	0	0	1	0	0	1	1
Pools or depressions in channels (wet or dry channels)	1	1	1	0	0	0	0	0
Riffles or rapids (wet channel) or planar bed (dry channel)	1	1	0	0	0	0	0	0
Non-vegetated flats or bare ground (sandflats, mudflats, gravel flats, etc.)	0	0	1	1	1	1	1	1
Point bars and in-channel bars	1	1	1	0	0	0	0	0
Debris jams	1	1	1	0	0	1	0	0
Abundant wrackline or organic debris in channel, on floodplain, or across depressional wetland plain	1	1	1	1	0	1	0	0
Plant hummocks and/or sediment mounds	1	1	1	1	1	1	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1	1	1	0	1	0	0
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1	0	1	0	1	0	0
Animal mounds and burrows	0	0	1	1	1	0	1	1
Standing snags (at least 3 m tall)	1	1	1	1	1	1	0	0
Filamentous macroalgae or algal mats	1	1	1	1	1	1	1	1
Shellfish beds	0	0	1	0	0	1	0	0
Concentric or parallel high water marks	0	0	0	1	1	1	1	1
Soil cracks	0	0	1	1	0	1	1	1
Cobble and/or Boulders	1	1	0	0	1	1	1	0
Submerged vegetation	1	0	1	1	0	1	0	0
Total Possible	16	11	15	13	10	16	10	10
No. Observed Patch Types (enter here and use in Table 4.16 below)								

Table 4.16: Rating of Structural Patch Richness (based on results from worksheets).

Rating	Confined Riverine, Playas, Springs & Seeps, Individual Vernal Pools	Vernal ,Pool Systems and Depressional	Estuarine	Non- confined Riverine, Lacustrine
A	≥ 8	≥ 11	≥ 9	≥ 12
B	6 – 7	8 – 10	6 – 8	9 – 11
C	4 – 5	5 – 7	3 – 5	6 – 8
D	≤ 3	≤ 4	≤ 2	≤ 5

Topographic Complexity

Definition: Topographic complexity refers to the variety of elevations within a wetland due to physical, abiotic features and elevations gradients.

Table 4.17: Typical indicators of Macro- and Micro-topographic Complexity for each wetland type.

Type	Examples of Topographic Features
Depressional and Playas	pools, islands, bars, mounds or hummocks, variegated shorelines, soil cracks, partially buried debris, plant hummocks, livestock tracks
Estuarine	channels large and small, islands, bars, pannes, potholes, natural levees, shellfish beds, hummocks, slump blocks, first-order tidal creeks, soil cracks, partially buried debris, plant hummocks
Lacustrine	islands, bars, boulders, cliffs, benches, variegated shorelines, cobble, boulders, partially buried debris, plant hummocks
Riverine	pools, runs, glides, pits, ponds, hummocks, bars, debris jams, cobble, boulders, slump blocks, tree-fall holes, plant hummocks
Slope Wetlands	pools, runnels, plant hummocks, burrows, plant hummocks, cobbles, boulders, partially buried debris, cattle or sheep tracks
Vernal Pools and Pool Systems	soil cracks, “mima-mounds,” rivulets between pools or along swales, cobble, plant hummocks, cattle or sheep tracks

Figure 4.6: Scale-independent schematic profiles of Topographic Complexity.

Each profile A-D represents one-half of a characteristic cross-section through an AA. The right end of each profile represents either the buffer along the backshore of the wetland encompassing the AA, or, if the AA is not contiguous with the buffer, then the right end of each profile represents the edge of the AA.

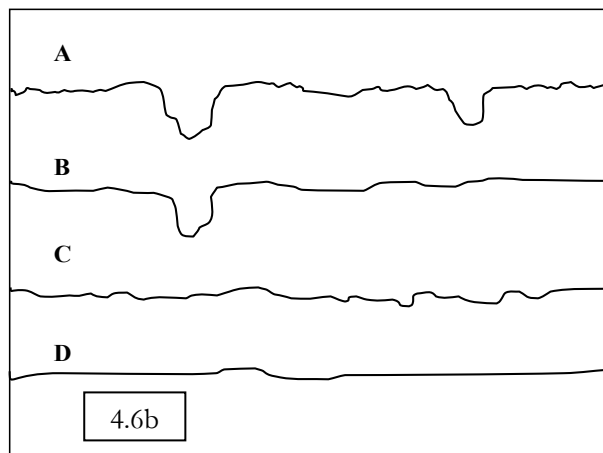


Table 4.18b: Rating of Topographic Complexity for all Estuarine Wetlands.

Rating	Alternative States (based on diagrams in Figure 4.6 above)
A	The vegetated plain of the AA in cross-section has a variety of micro-topographic features created by plants, animal tracks, cracks, partially buried debris, retrogressing channels (filling-in with sediment and plants), natural levees along channels, potholes and pannes that together comprise a complex array of ups and downs resembling diagram A in Figure 4.6b.
B	The vegetated plain of the AA has a variety of micro-topographic features as described above for “A” but they are less abundant and/or they comprise less variability in elevation overall, as illustrated in diagram B of Figure 4.6b.
C	The vegetated plain of the AA has a variety of micro-topographic features as described above for “A” but lacks well-formed tidal channels that are well-drained during ebb tide. If channels exist, they mostly do not drain well or are filling-in with sediment. The plain overall resembles diagram C of Figure 4.6b.
D	The vegetated plain of the AA has little or no micro-topographic relief and few or no well-formed channels. The plain resembles diagram D of Figure 4.6b.

Attribute 4: Biotic Structure

Plant Community Metric

Definition: The Plant Community Metric is composed of three submetrics for each wetland type. Two of these sub-metrics, Number of Co-dominant Plants and Percent Invasion, are common to all wetland types. For all wetlands except Vernal Pools and Vernal Pool Systems, the Number of Plant Layers as defined for CRAM is also assessed. For Vernal Pools and Pool Systems, the Number of Plant layers submetric is replaced by the Native Species Richness submetric. A thorough reconnaissance of an AA is required to assess its condition using these submetrics. The assessment for each submetric is guided by a set of Plant Community Worksheets. The Plant Community metric is calculated based on these worksheets.

A “plant” is defined as an individual of any species of tree, shrub, herb/forb, moss, fern, emergent, submerged, submergent or floating macrophyte, including non-native (exotic) plant species. For the purposes of CRAM, a plant “layer” is a stratum of vegetation indicated by a discrete canopy at a specified height that comprises at least 5% of the area of the AA where the layer is expected.

Non-native species owe their occurrence in California to the actions of people since shortly before Euroamerican contact. “Invasive” species are non-native species that tend to dominate one or more plant layers within an AA. CRAM uses the California Invasive Plant Council (Cal-IPC) list to determine the invasive status of plants, with augmentation by regional experts.

Number of Plant Layers Present

To be counted in CRAM, a layer must cover at least 5% of *the portion of the AA that is suitable for the layer*. This would be the littoral zone of lakes and depressional wetlands for the one aquatic layer, called “floating.” The “short,” “medium,” and “tall” layers might be found throughout the non-aquatic areas of each wetland class, except in areas of exposed bedrock, mudflat, beaches, active point bars, etc. The “very tall” layer is usually expected to occur along the backshore, except in forested wetlands.

It is essential that the layers be identified by the actual plant heights (i.e., the approximate maximum heights) of plant species in the AA, regardless of the growth potential of the species. For example, a young sapling redwood between 0.5 m and 0.75 m tall would belong to the “medium” layer, even though in the future the same individual redwood might belong to the “very tall” layer. Some species might belong to multiple plant layers. For example, groves of red alders of all different ages and heights might collectively represent all four non-aquatic layers in a riverine AA. Riparian vines, such as wild grape, might also dominate all of the non-aquatic layers.

Layer definitions:

Floating Layer. This layer includes rooted aquatic macrophytes such as *Ruppia cirrhosa* (ditchgrass), *Ranunculus aquatilis* (water buttercup), and *Potamogeton foliosus* (leafy pondweed) that create floating or buoyant canopies at or near the water surface that shade the water column. This layer also includes non-rooted aquatic plants such as *Lemna* spp. (duckweed) and *Eichhornia crassipes* (water hyacinth) that form floating canopies.

Short Vegetation. This layer varies in maximum height among the wetland types, but is never taller than 50 cm. It includes small emergent vegetation and plants. It can include young forms of species that grow taller. Vegetation that is naturally short in its mature stage includes *Rorippa nasturtium-aquaticum* (watercress), small Isoetes (quillworts), *Distichlis spicata* (saltgrass), *Jaumea carnosa* (jaumea), *Ranunculus flamula* (creeping buttercup), *Alisma* spp. (water plantain), *Sparganium* (burweeds), and *Sagittaria* spp. (arrowhead).

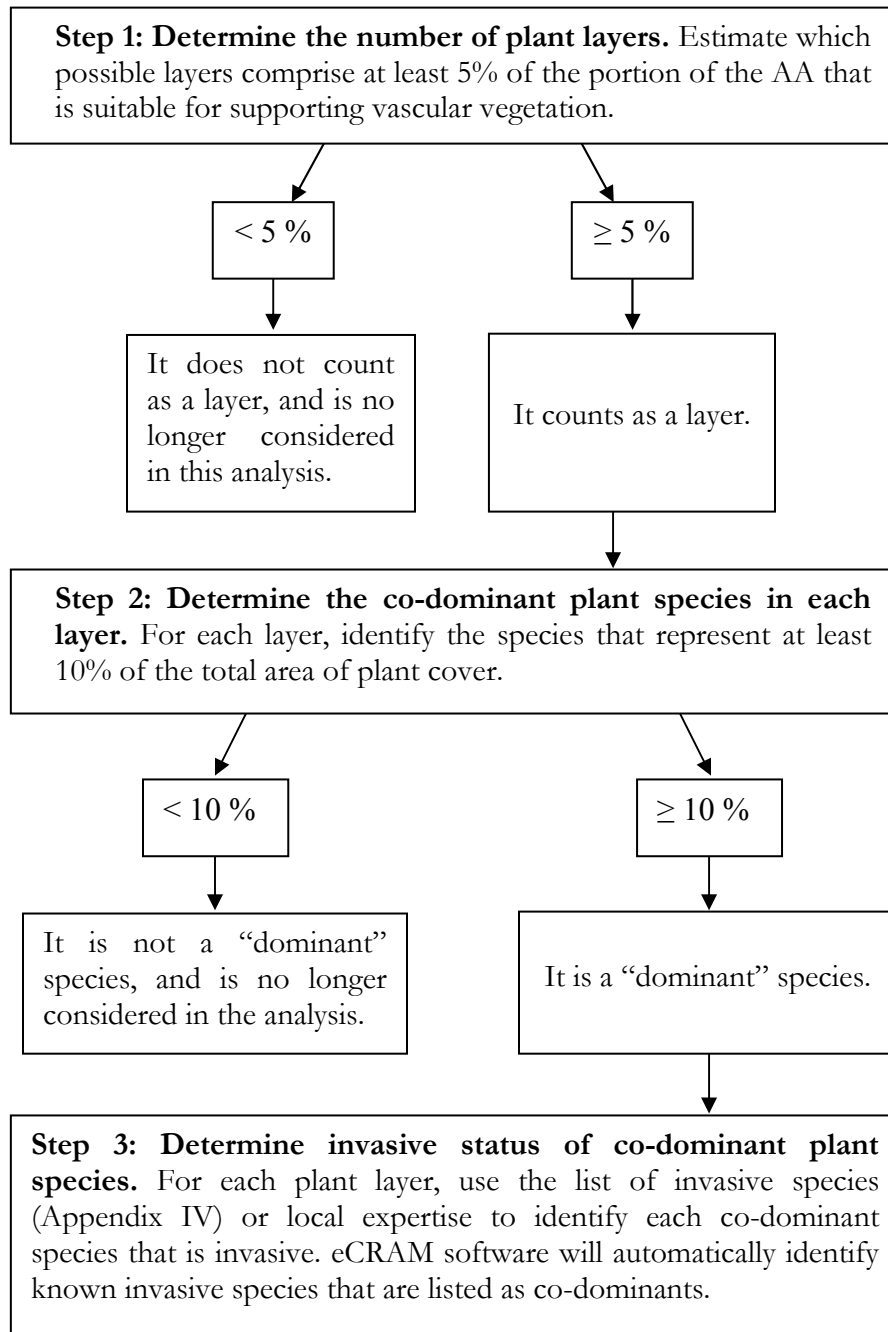
Medium Vegetation. This layer never exceeds 75 cm in height. It commonly includes emergent vegetation such *Salicornia virginica* (pickleweed), *Atriplex* spp. (saltbush), rushes (*Juncus* spp.), and *Rumex crispus* (curly dock).

Tall Vegetation. This layer never exceeds 1.5 m in height. It usually includes the tallest emergent vegetation and the larger shrubs. Examples include *Typha latifolia* (broad-leaved cattail), *Scirpus californicus* (bulrush), *Rubus ursinus* (California blackberry), and *Baccharis pilularis* (coyote brush).

Very Tall Vegetation. This layer is reserved for shrubs, vines, and trees that are taller than 1.5 m. Examples include *Plantanus racemosa* (western sycamore), *Populus fremontii* (Fremont cottonwood), *Alnus rubra* (red alder), *Sambucus mexicanus* (Blue elderberry), and *Corylus californicus* (hazelnut).

Standing (upright) dead or senescent vegetation from the previous growing season can be used in addition to live vegetation to assess the number of plant layers present. However, the lengths of prostrate stems or shoots are disregarded. In other words, fallen vegetation should not be “held up” to determine the plant layer to which it belongs. The number of plant layers must be determined based on the way the vegetation presents itself in the field.

Appendix I: Flow Chart to Determine Plant Dominance



Plant Community Metric Worksheet 1 of 8: Plant layer heights for all wetland types.

Wetland Type	Plant Layers				
	Aquatic	Semi-aquatic and Riparian			
	Floating	Short	Medium	Tall	Very Tall
Perennial Saline Estuarine	On Water Surface	<0.3 m	0.3 – 0.75 m	0.75 – 1.5 m	>1.5 m
Perennial Non-saline Estuarine, Seasonal Estuarine	On Water Surface	<0.3 m	0.3 – 0.75 m	0.75 – 1.5 m	>1.5 m
Lacustrine, Depressional and Non-confined Riverine	On Water Surface	<0.5 m	0.5 – 1.5 m	1.5 – 3.0 m	>3.0 m
Slope	NA	<0.3 m	0.3 – 0.75 m	0.75 – 1.5 m	>1.5 m
Confined Riverine	NA	<0.5 m	0.5 – 1.5 m	1.5 – 3.0 m	>3.0 m

Number of Co-dominant Species

For each plant layer in the AA, all species represented by living vegetation that comprises at least 10% relative cover within the layer are considered to be dominant. Only living vegetation in growth position is considered in this metric. Dead or senescent vegetation is disregarded.

Percent Invasion

The number of invasive co-dominant species for all plant layers combined is assessed as a percentage of the total number of co-dominants, based on the results of the Number of Co-dominant Species sub-metric. The invasive status for many California wetland and riparian plant species is based on the Cal-IPC list (Appendix IV). However, the best professional judgment of local experts may be used instead to determine whether or not a co-dominant species is invasive.

**Plant Community Metric Worksheet 2 of 8: Co-dominant species richness for
all wetland types, except Confined Riverine, Slope wetlands, Vernal Pools, and Playas
(A dominant species represents $\geq 10\%$ *relative cover*)**

Note: Plant species should only be counted once when calculating the Number of Co-dominant Species and Percent Invasion metric scores.

Floating or Canopy-forming	Invasive?	Short	Invasive?
Medium	Invasive?	Tall	Invasive?
Very Tall	Invasive?		
		Total number of co-dominant species for all layers combined (enter here and use in Table 4.19)	
		Percent Invasion (enter here and use in Table 4.19)	

Table 4.19: Ratings for submetrics of Plant Community Metric.

Rating	Number of Plant Layers Present	Number of Co-dominant Species	Percent Invasion
Perennial Saline Wetlands			
A	4 – 5	≥ 5	0 – 15%
B	2 – 3	4	16 – 30%
C	1	2 – 3	31 – 45%
D	0	0 – 1	46 – 100%
Perennial Non-Saline and Seasonal Estuarine Wetlands			
A	4 – 5	≥ 7	0 – 20%
B	3	5 – 6	21 – 35%
C	1 – 2	3 – 4	36 – 60%
D	0	0 – 2	61 – 100%

Horizontal Interspersion and Zonation

Definition: Horizontal biotic structure refers to the variety and interspersion of plant “zones.” Plant zones are plant monocultures or obvious multi-species association that are arrayed along gradients of elevation, moisture, or other environmental factors that seem to affect the plant community organization in plan view. Interspersion is essentially a measure of the number of distinct plant zones and the amount of edge between them.

Table 4.20a: Rating of Horizontal Interspersion of Plant Zones for all AAs except Riverine and Vernal Pool Systems.

Rating	Alternative States (based on Figures 4.7, 4.8, and 4.10)
A	AA has a high degree of plan-view interspersion.
B	AA has a moderate degree of plan-view interspersion.
C	AA has a low degree of plan-view interspersion.
D	AA has essentially no plan-view interspersion.

Note: When using this metric, it is helpful to assign names of plant species or associations of species to the colored patches in Figure 4.10.

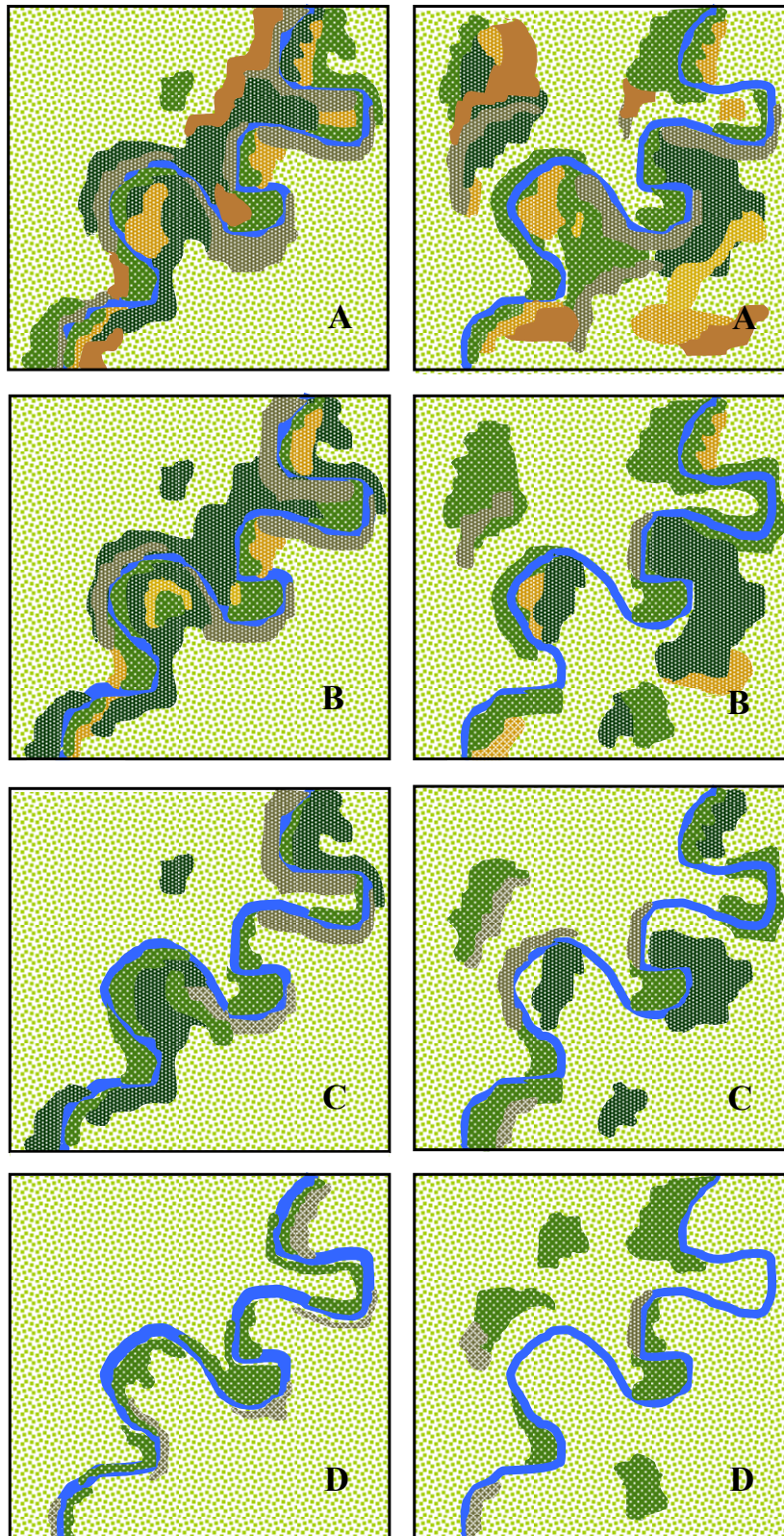


Figure 4.10: Schematic diagrams of varying degrees of interspersions of plant zones and patches for Perennial Saline, Non-saline, and Seasonal Estuarine wetlands. In these diagrams, each plant zone or patch type has a unique color and comprises at least 5% of the AA. There are two examples for each condition A-D. The left-side example in each pair shows zones or patches organized around a tidal channel, and the right-side example in each pair shows patches or zones that are more broadly distributed across the wetland plain.

Vertical Biotic Structure

Definition: The vertical component of biotic structure consists of the interspersion and complexity of plant layers. The same plant layers used to assess the Plant Community Composition Metrics (see Section 4.4.2) are used to assess Vertical Biotic Structure. To be counted in CRAM, a layer must cover at least 5% of the portion of the AA that is suitable for the layer. This metric does not pertain to Vernal Pools, Vernal Pool Systems, or Playas.

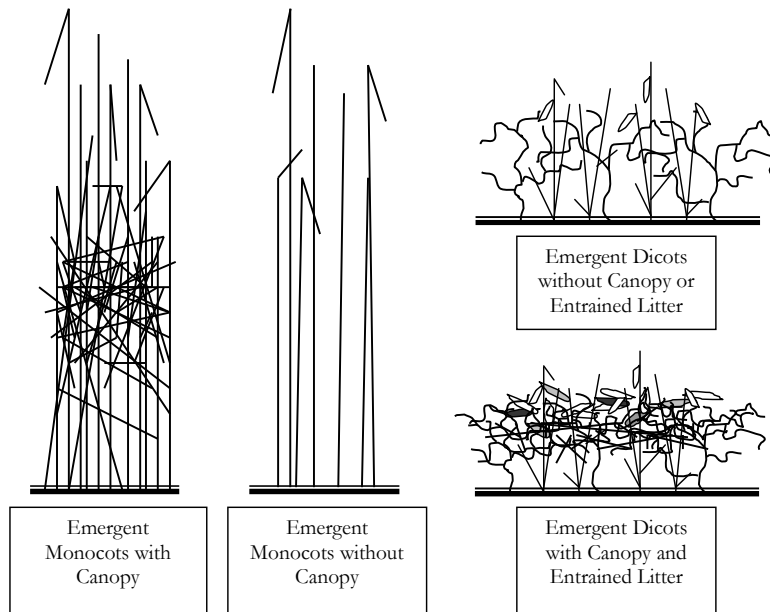


Figure 4.12: Schematic diagrams of plant canopies and entrained litter used to assess Vertical Biotic Structure in all Estuarine wetlands, or in Depressional and Lacustrine wetlands dominated by emergent monocots or lacking Tall and Very Tall plant layers.

Table 4.22: Rating of Vertical Biotic Structure for wetlands dominated by emergent monocots or lacking Tall and Very Tall plant layers, especially Estuarine saline wetlands (see Figure 4.12).

Rating	Alternative States
A	Most of the vegetated plain of the AA has a dense canopy of living vegetation or entrained litter or detritus forming a “ceiling” of cover 10-20 cm of above the wetland surface that shades the surface and can provide abundant cover for wildlife.
B	Less than half of the vegetated plain of the AA has a dense canopy of vegetation or entrained litter as described in “A” above; OR Most of the vegetated plain has a dense canopy but the ceiling it forms is much less than 10-20 cm above the ground surface.
C	Less than half of the vegetated plain of the AA has a dense canopy of vegetation or entrained litter AND the ceiling it forms is much less than 10-20 cm above the ground surface.
D	Most of the AA lacks a dense canopy of living vegetation or entrained litter or detritus.

Guidelines to Complete the Stressor Checklists

Definition: A stressor, as defined for the purposes of the CRAM, is an anthropogenic perturbation within a wetland or its environmental setting that is likely to negatively impact the condition and function of the CRAM Assessment Area (AA). A disturbance is a natural phenomenon that affects the AA.

There are four underlying assumptions of the Stressor Checklist: (1) deviation from the best achievable condition can be explained by a single stressor or multiple stressors acting on the wetland; (2) increasing the number of stressors acting on the wetland causes a decline in its condition (there is no assumption as to whether this decline is additive (linear), multiplicative, or is best represented by some other non-linear mode); (3) increasing either the intensity or the proximity of the stressor results in a greater decline in condition; and (4) continuous or chronic stress increases the decline in condition.

The process to identify stressors is the same for all wetland types. For each CRAM attribute, a variety of possible stressors are listed. Their presence and likelihood of significantly affecting the AA are recorded in the Stressor Checklist Worksheet. For the Hydrology, Physical Structure, and Biotic Structure attributes, the focus is on stressors operating within the AA or within 50 m of the AA. For the Buffer and Landscape Context attribute, the focus is on stressors operating within 500 m of the AA. More distant stressors that have obvious, direct, controlling influences on the AA can also be noted.

Table 5.1: Wetland disturbances and conversions.

Has a major disturbance occurred at this wetland?	Yes	No		
If yes, was it a flood, fire, landslide, or other?	flood	fire	landslide	other
If yes, then how severe is the disturbance?	likely to affect site next 5 or more years	likely to affect site next 3-5 years	likely to affect site next 1-2 years	
Has this wetland been converted from another type? If yes, then what was the previous type?	depressional	vernal pool	vernal pool system	
	non-confined riverine	confined riverine	seasonal estuarine	
	perennial saline estuarine	perennial non-saline estuarine	wet meadow	
	lacustrine	seep or spring	playa	

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)		
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows		
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology		
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Filling or dumping of sediment or soils (N/A for restoration areas)		
Grading/ compaction (N/A for restoration areas)		
Plowing/Discing (N/A for restoration areas)		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., <i>Virginia opossum</i> and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Urban residential		
Industrial/commercial		
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)		
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

CRAM Score Guidelines

Table 3.11: Steps to calculate attribute scores and AA scores.

Step 1: Calculate Metric Score	For each Metric, convert the letter score into the corresponding numeric score: A=12, B=9, C=6 and D=3.
Step 2: Calculate raw Attribute Score	<p>For each Attribute, calculate the Raw Attribute Score as the sum of the numeric scores of the component Metrics, except in the following cases:</p> <ul style="list-style-type: none"> For Attribute 1 (Buffer and Landscape Context), the submetric scores relating to buffer are combined into an overall buffer score that is added to the score for the Landscape Connectivity metric, using the following formula: $\left(\boxed{\text{Buffer Condition}} \times \left(\boxed{\% \text{ AA with Buffer}} \times \boxed{\text{Average Buffer Width}} \right)^{\frac{1}{2}} \right)^{\frac{1}{2}} + \boxed{\text{Landscape Connectivity}}$ <ul style="list-style-type: none"> Prior to calculating the Biotic Structure Raw Attribute Score, average the three Plant Community sub-metrics. For vernal pool systems, first calculate the average score for all three Plant Community sub-metrics for each replicate pool, then average these scores across all six replicate pools, and then calculate the average Topographic Complexity score for all six replicates.
Step 3: Calculate final Attribute Score	For each Attribute, divide its Raw Attribute Score by its maximum possible score, which is 24 for Buffer and Landscape Context, 36 for Hydrology, 24 for Physical Structure, and 36 for Biotic Structure.
Step 4: Calculate the AA Score	Calculate the AA score by averaging the Final Attribute Scores. Round the average to the nearest whole integer.